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SURFACE CATCHES OF MARINE DIATOMS AND DINOFLAGELLATES FROM PACIFIC HIGH SEAS IN 1925 AND 1926

BY

WINFRED EMORY ALLEN AND RALPH LEWIS

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CONTENTS

	PAGE
Introduction	197
Cortez Bank series	198
Revillagigedo series	198
Discoverer-Hawaiian series	199
Mid-ocean series	199
Omaha-Hawaiian series	199
Australian series	199
Genera and species	200
Conclusion	200
Literature cited	200

INTRODUCTION

In this paper the term "high seas" indicates oceanic areas not only outside of headlands, but also at distances from shore far enough to obscure, or even to obliterate, evidences of direct influence of land conditions.

In the course of several years the Scripps Institution has accumulated, in a total of ten series, some hundreds of catches from surface waters in widely different high seas areas of the Pacific Ocean. Six of those series have contributed the material for this paper. Discussion of this differing material has been included under one title because the catches have all been too light to be statistically significant, although they have high value as authentic records of observed conditions, and considerable value as indicators that the high seas region is normally barren at the surface level.

The series discussed herein are respectively as follows: (1) twenty-four catches taken by the U. S. Coast and Geodetic Survey Steamer "Guide," while working between San Pedro and Cortez Bank off the coast of southern California in March to May, 1925; (2) forty-five catches taken in April, 1925 by the California Academy of Sciences on a trip from San Diego to Guadalupe Island and Revillagigedo Islands, off the shores of Lower California and Mexico; (3) forty-seven catches taken by the U. S. Coast and Geodetic Survey Steamer

"Discoverer" between San Francisco and Hawaii in 1925–26; (4) fifty-seven catches taken by the U.S.S. "Omaha," flagship of the Pacific destroyer fleet, to a point about eight hundred miles west of Lower California in March, 1925; (5) fifty-eight catches taken by the U.S.S. "Omaha" between San Francisco and Hawaii in April, 1925; (6) one hundred and forty-two catches taken by the U.S.S. "Omaha" between Hawaiian and Australian waters in July and August, 1925.

The method of collecting was the same in all of these series, i.e., a bucket was lowered from the ship (without slacking speed) and a measured amount of water was dipped from the surface of the sea and poured through a small net of No. 25 silk (average diameter of openings about .05 mm.) for filtration. Three gallons of water were filtered in the first series, varying quantities in the third, and five gallons in each of the others.

Studies of the first three series were made by the junior author, and of the last three series by the senior author.

Cortez Bank Series

The larger number of the twenty-four catches in this series were taken in the area between Santa Catalina and San Clemente Islands and in the vicinity of Cortez Bank. The largest haul of diatoms was made near the southwestern part of Santa Catalina Island, and showed 23,379 cells to the liter. Only one other catch yielded as many as one thousand cells to the liter. Only two catches of dinoflagellates showed as many as one thousand cells to the liter. This general exhibition of poor production of diatoms at the surface level in this region is in harmony with other records, although some of these show occasional catches of considerable size (cf. Allen, 1923).

Revillagigedo Series

The greater number of the forty-five catches in this series were made on the part of the trip between Guadalupe Island and Revillagigedo Islands. No catch in this part of the series yielded as many as one thousand cells to the liter of total diatoms and dinoflagellates. In fact, only two catches of greater size were taken anywhere after leaving San Diego. One of these, 11,784 diatom cells to the liter, was taken not far from San Diego, and the other, 3,564 diatom cells to the liter, was slightly northeast of Guadalupe Island. Some catches made by Mr. P. S. Barnhart in July, 1922 (Allen, 1924) give a similar indication of poor production on the high seas in the Guadalupe region.

Discoverer-Hawaiian Series

All the forty-seven catches in this series were made far from shore on the trip from San Francisco to Hawaii. Only nineteen catches showed any diatoms and only ten catches showed any dinoflagellates. In no case was the combined number of diatoms and dinoflagellates as great as three hundred cells to the liter. Note similar results in the fifth series.

Mid-Ocean Series

Almost all these catches were made near a line running eight hundred miles westward from Guadalupe Island. Only twenty-one of the fifty-seven catches showed specimens of either diatoms or dinoflagellates, and no catch yielded a total number of cells greater than six hundred.

Omaha-Hawaiian Series

All the collecting of this series was done on the high seas on the direct route from San Francisco to Honolulu. Only twenty-six of the fifty-eight catches showed either diatoms or dinoflagellates. The largest catch yielded less than three hundred cells to the liter. This poor showing in production is particularly notable because it is observed at a time of year when production is usually found to be at least fairly good at inshore stations. Taken with the poor showing of the Discoverer-Hawaiian series in December, it is strongly indicative of lack of fertility in the surface level of the high seas in this region.

Australian Series

Most of the collecting of this series was done between Hawaii and Australia, but some samples were obtained from New Zealand waters. Twenty-three of the one hundred and forty-two catches contained both diatoms and dinoflagellates. Sixty-three catches lacked both. No catches yielded numbers of cells greater than five hundred to the liter. On account of the seasons of the year of this series, late summer north, and late winter south, of the equator, the poor production indicated would not be surprising in any region. The most productive localities are likely to make a similar poor showing at these seasons.

Genera and Species

In consideration of the small numbers of cells in the catches, the number of genera and species was surprisingly large; thirty-five species, representing twenty-three genera of diatoms in the series between Hawaii and Australia. In all the series the majority of the genera and species were cosmopolitan and had been found more or less frequently near the California coast. Examples of these are *Nitzschia seriata* Cleve., *Rhizosolenia semispina* Hensen, *Chaetoceras debile* Cleve, and *Hemiaulus hauckii* Grünow. Dinoflagellates were consistently fewer in genera and species, as well as in numbers of individuals, in all series.

Conclusion

Since most of the species observed in all series seemed to be normal in form and in good condition, it may be supposed that there was nothing directly injurious in their high seas environment, even though it does not appear to be favorable. It is possible that the few specimens usually found at the surface are marginal representatives of a large population having greatest density at a considerable depth.

On the other hand, it may be supposed that on the high seas food supplies are too scanty to support a resident population and that only strongly migrating organisms or thinly distributed representatives of passive types can find means for survival.

Although the strongly harmonious showing of poor production by several series over widely different areas of the high seas is impressive, it should not be forgotten that these series are not closely related in time and that they show nothing of subsurface conditions. It will take a vastly greater amount of work than has yet been done to give a satisfactory understanding of life in ocean waters far from shore.

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